

# Wildfires in Evros region, Greece

Maria Antoniacci

Scienze e Gestione della Natura - Unibo

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# Outline

## 1 Introduction

## 2 Objectives

## 3 Materials and methods

## 4 Analysis - 1

## 5 Analysis - 2

## 6 Conclusions

# 2023 Wildfires in Greece



Source: Sentinel-2, processed by ESA, 2023.

In August 2023, a massive wildfire broke out in the **Evros** region of northeastern Greece, reaching Alexandroupolis.

Approximately **80,000 hectares** of land were burned, including the forest within the Dadia - Lefkimi - Soufli Forest National Park.

This event is considered to be the largest wildfire ever recorded in Europe since 2000.

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# Objectives

The objectives of the analysis are:

- 1: Assessing **Pre- and Post- Wildfire Conditions** using the Normalized Burn Ratio (**NBR** and **dNBR**)
- 2: Evaluating **Vegetation Recovery Trends** over the years in June using the Normalized Difference Vegetation Index (**NDVI**)

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# Data collection

Sentinel-2 satellite images were taken from **Copernicus Browser**

- Selecting area of interest
- Filtering with cloud coverage lower than 10%
- Downloading single bands B4, B3, B2 for True color, B8 (NIR), B12 (SWIR)
- Downloading in *.tiff*

# Packages

The analyses require the following packages:

- terra
- imageRy
- viridis
- ggplot2
- patchwork

# Main functions

- `library()`
- `setwd()`
- `rast()`
- `im.plotRGB()`
- `plot()`
- `par()`
- `viridis()`
- `im.classify()`
- `freq()`
- `ncell()`
- `data.frame()`
- `ggplot()`
- `patchwork()`
- `focal()`

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# Before and After the Wildfire

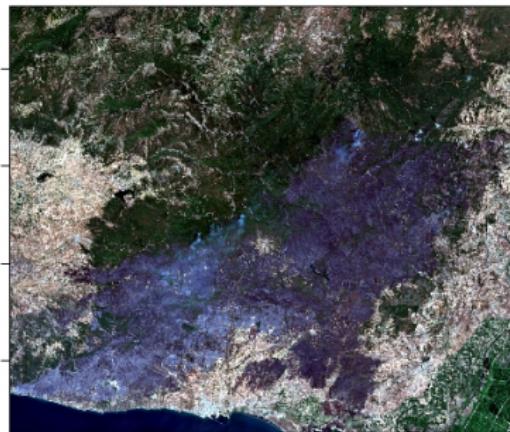
Assessing Pre- and Post- Wildfire conditions in southern Evros.

True Colors

**8 August**



**28 August**



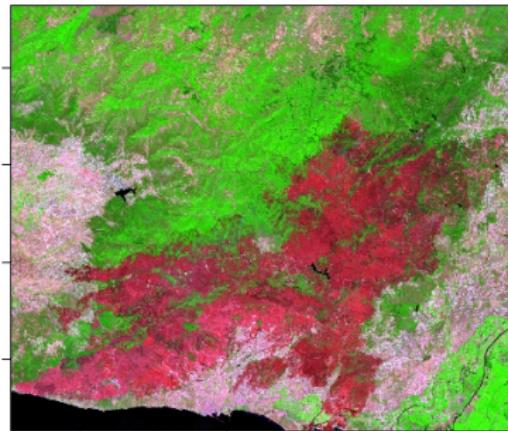
# Spectral Indices - SWIR

SWIR (Short-Wave InfraRed) shows **high reflectance on burned vegetation** and low reflectance of healthy vegetation.

8 August in SWIR



28 August in SWIR

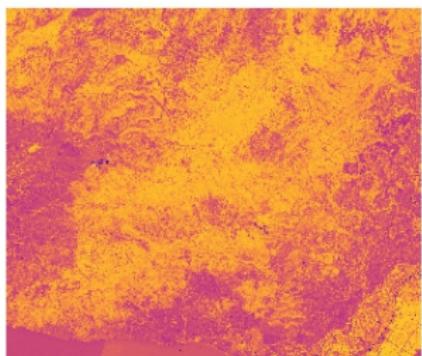


# Spectral Indices - NBR

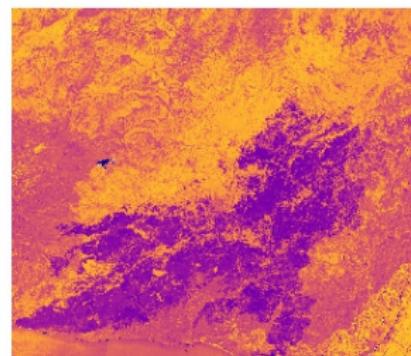
To analyze images **after wildfires** NBR index is used.

**Normalized Burn Ratio (NBR)** is a normalized index that uses SWIR and NIR bands.

8 August in NBR



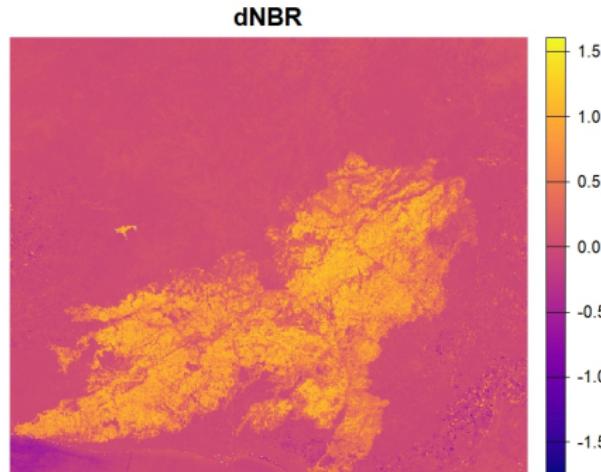
28 August in NBR



# Spectral Indices - dNBR

**dNBR** is used to assess the severity of the burn. It is the difference between NBR before and after the fire.

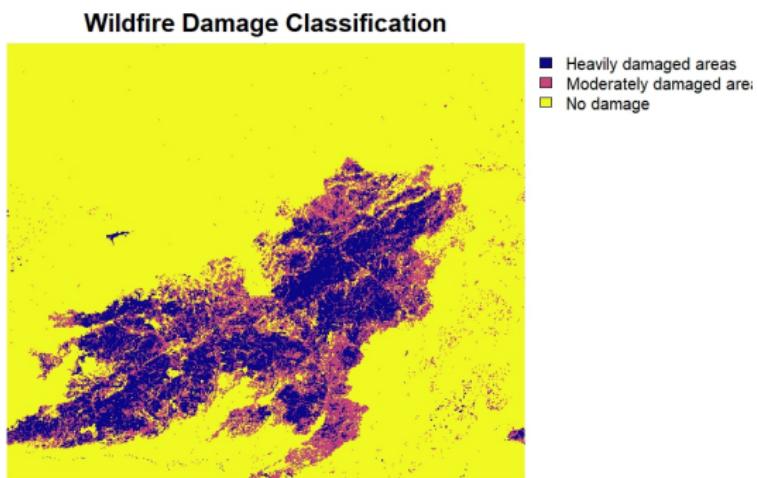
Higher positive dNBR values indicate greater **burn severity**.



# Wildfire Damage Classification

Identifying levels of damage in Evros area based on dNBR:

- Severely damaged=13%
- Moderately damaged=12%



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# Vegetation Recovery Trends

Evaluating Vegetation Dynamics over the years

June 2023



June 2024



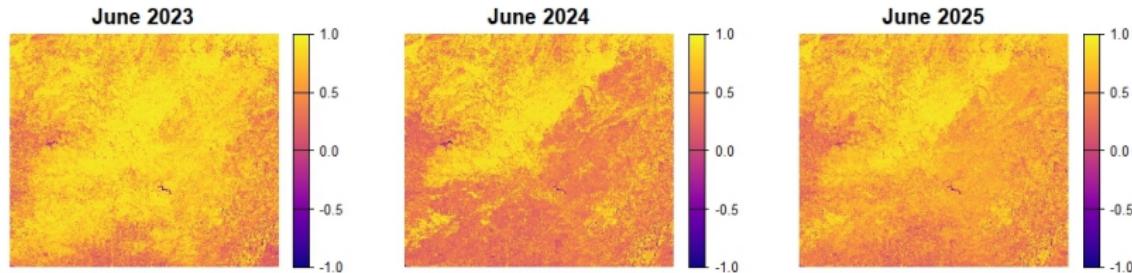
June 2025



# Spectral Indices - NDVI

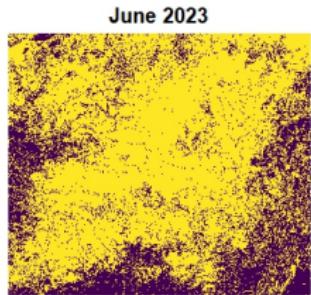
**Normalized Difference Vegetation Index (NDVI)** is used here to assess how vegetation responds to disturbance caused by fire over time.

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

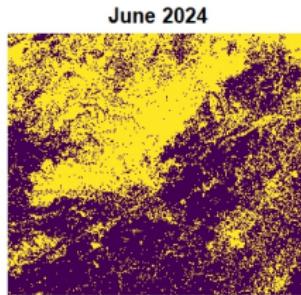


# NDVI-based Classification

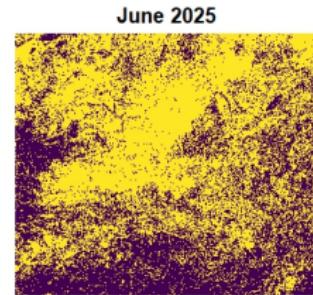
NDVI-based classification helps visualize vegetation dynamics over three years by showing variations between damaged and healthy areas.



June 2023



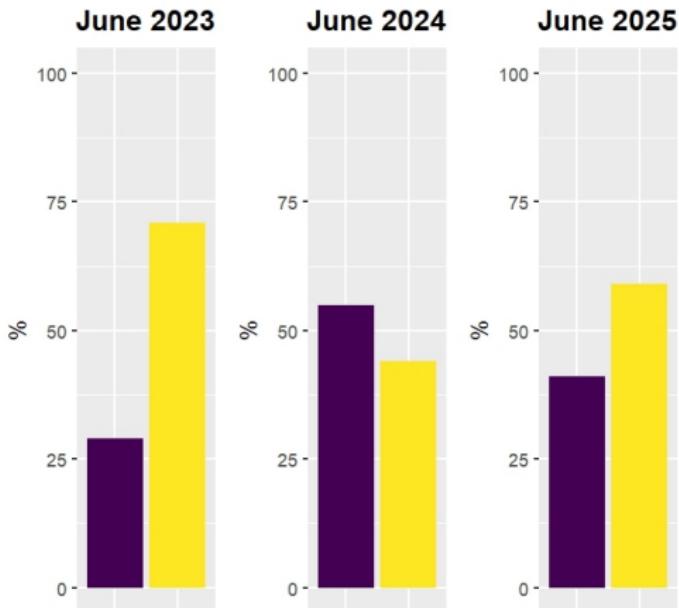
June 2024



June 2025

- Damaged vegetation and Artificial areas
- Healthy vegetation

# NDVI-based Classification



Percentages of vegetation in good condition over the years:

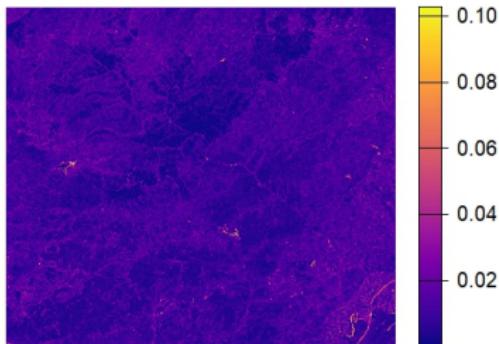
- June 2023: 71%
- June 2024: 44%
- June 2025: 59%

The data suggest that **vegetation is slowly recovering**.

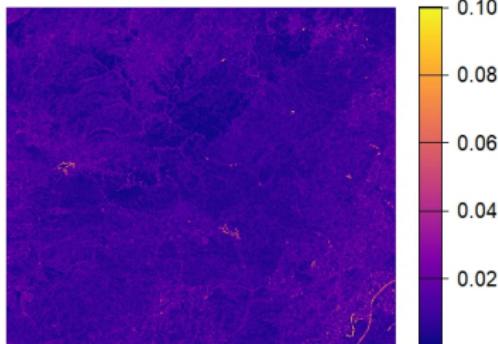
# Measuring Spatial Variability on NDVI

Moving Window 3x3

Local SD June 2024



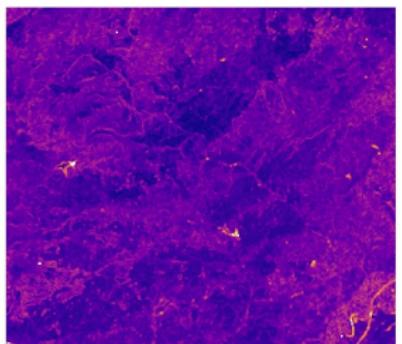
Local SD June 2025



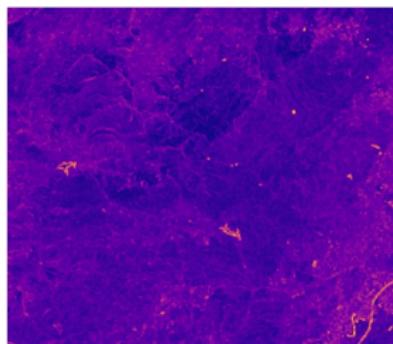
# Measuring Spatial Variability on NDVI

Moving Window **7x7**

**Local SD June 2024**



**Local SD June 2025**



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# Considerations

To summarize the result of the analyses:

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- NDVI shows a decline in 2024, followed by a partial recovery of vegetation in 2025

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- Approximately 25% of the study area in southern Evros was moderately to severely damaged by the wildfire
- NBR and dNBR map burn severity effectively
- NDVI shows a decline in 2024, followed by a partial recovery of vegetation in 2025
- Local Standard Deviation Measure reveals differences in spatial variability between 2024 and 2025

Thank you for your attention!